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8th Grade Student's Skill of Connecting Mathematics to Real Life

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Abstract

The purpose of this study is to examine 8th grade students' skills of connecting mathematics to real life. This study uses survey design since it aims to determine existing situations regarding to students' skills of connecting mathematics to real life. The study sample consists of 176 students in total, who are studying at a state school in the Etimesgut district of Ankara in the second semester of 2016-2017 academic year. "Connecting mathematics to real life scale" which is developed by the researchers, used as the data collection tool of this study. In this scale, students are provided with real life situations and then asked to connect these situations with mathematical concepts. During the data analysis, the responses of students examined in detail and subsequently general categories (levels) which identify students' mathematical connection skill, were created and consequently four levels of connecting (Level 1, 2, 3 and 4) were defined. Study findings are showed that, participating 8th grade students' skill of connecting mathematics to real life is not in sufficient level. It is observed that, most of the students can only connect mathematics in real life with numbers and shapes.

Keywords: mathematics education, connection skill, mathematics in real life, middle grade students, realistic mathematics education

1. Introduction

There is no doubt that the mathematics exists in all areas of the life. Mathematics has taken its place in our life not only with numbers or calculations but also with way of thinking, with its concepts (Umay, 2003). Actually we use the mathematics all the time, when we are holding our plane ticket and try to find the seat or when we are parking our car or playing billiards or painting. The ability of students to establish this connection between mathematics and real life is crucial with regards to recognition of mathematics in everyday life, accurate recognition of mathematics and to develop conceptual learning. As a matter of fact, the significance of the "mathematical connection" skill, which is determined as one of the process standards in the Principles and Standards for School Mathematics by the National Council of Teachers of Mathematics in the United States, defined as follows: If students can connect mathematical ideas, their understanding will be deeper and more permanent, and mathematics will be seen as a whole (NCTM, 2000). The conducted researches also emphasizes that the idea of using real life connections in mathematics teaching increases the students interest's and motivation's towards mathematics, develops a positive attitude about mathematics, contributes to students for their preparation of real life and develop conceptual understanding (Mosvold, 2008; Lee, 2012; Özgen, 2013; Karakoç & Alacacı, 2015; Bingölbali & Çoşkun, 2016; Papadakis, Kalogiannakis, & Zaranis, 2017).

Our curriculum is also expected to improve the mathematical connection skills of the students. In Turkey, the updated mathematics curriculum of 2017 (Elementary and Middle Grade; 1st, 2nd, 3rd, 4th, 5th, 6th, 7th and 8th grades) added mathematical connection skill under the title of basic skills and emphasized that connection skill should be reinforced in all mathematics topics and at every grade level (Ministry of National Education, 2017). When the curriculum is examined, it can be seen that the making connection between mathematics and other lessons, between concepts within mathematics itself, and between mathematics and everyday life are questioned. In this context, it can be understood that the curriculum provides example statements on the basis of learning outcome about making connection within mathematics itself as well as between mathematics and real life. Explaining "the involvement of the studies which connect perimeter of the rectangle to its area" in the field of 7th grade geometry and measurement learning fields in order to connect mathematics to the concepts within itself, shows that the curriculum emphasizes the efforts for the development of mathematical connection skill. In addition, curriculum gives some explanations in the field of 8th grade algebra about "the involvement of the studies which connect "how to determine the place of the coordinate system to real life situations" as an example for the connection of mathematics with the real life.

Students' skills of connecting mathematical concepts to real life also have an important role in the Realistic Mathematics Education theory developed by Freudenthal. Realistic Mathematics Education (RME) is a mathematical teaching model developed in the Netherlands. The most basic feature of RME is the development of mathematical concepts based on problems presented in real life contexts. The another feature of the theory is that students can recognize mathematical concepts in certain situations (Wubbels, Korthagen, & Broekman,1997; Van den Heuvel-Panhuizen, 2003; Widjaja & Heck, 2003; Zaranis, Kalogiannakis, & Papadakis, 2013; Van den Heuvel-Panhuizen & Drijvers, 2014). In RME theory, it is predicted that, students are taught mathematical concepts by providing examples from the real life situations that are meaningful for them (Van den Heuvel-Panhuizen, 2003). In the mathematics classes which are paying attention to RME theory, students should be encouraged to recognize and identify everyday life mathematics (Widjaja & Heck, 2003). According to Freudenthal, students should be offered opportunities to discover mathematics by mathematising real life situations. The materials that the students will mathematise must be real for them (Cobb, Zhao, & Visnovska, 2008). These real situations may be contextual problems or authentic contexts (Barnes, 2004).

1.1 Research Studies about Real Life Connections

In this study, the skill of connecting mathematics to real life is considered as the relationship between mathematics learned in school and mathematics learned in the outside world as described by Mosvold (2008). Although the importance of connecting mathematics to real life is emphasized in the curriculum and the teaching theories such as Realistic Mathematics Education, researches show that many people have difficulty in applying mathematical knowledge to real life (Mosvold, 2008). In fact, it is not wrong to state that when we talk about mathematics many people in society have only numbers, shapes and calculations in their mind. It is possible to see similar results even in researches conducted among teachers and teacher candidates (Umay, 2003; Garii & Okumu, 2008; Lee, 2012; Özgen, 2013; Pirasa, 2016). For example, Garii and Okumu (2008) were examined the skills of classroom teachers regarding to recognition of mathematics in everyday life. As a result of their research, they found out that teachers were not successful in connecting mathematics to real life and their connections were limited to fairly superficial calculations and algorithms. Although many teachers were emphasized that they could mathematically characterize the things in everyday life regarding to calculations such as buying gasoline and paying for it, they could not notice the mathematics behind the technology on the computer screen of the gas pump. At the same time, they have found in their research that teachers consider mathematics as a calculation tool used in real life.

Özgen (2013) has conducted a study with mathematics teacher candidates in order to examine the aforementioned three types of connection skills (the connection of mathematics to different disciplines, the connection of mathematics to itself, the connection of mathematics to real life) within the context of problem solving. As a result of the research, it is determined that the connection skills of the teacher candidates are low. In addition, it is also determined that the most used connection type by mathematics teacher candidates during the problem solving is the connection of mathematics to itself and therefore it is found out that their skills of connecting mathematics with different disciplines and with real life are low. In another study conducted with teacher candidates, Pirasa (2016) asked pre-service mathematics teachers to provide her real life examples for 21 geometry concepts defined in mathematics curriculum. As a result of the research, it is found that pre-service teachers can provide one example for each geometric concept in general. However, the examples provided by pre-service teachers were not found sufficient by the researcher.

Similarly, Umay (2003) has conducted a study with pre-school teacher candidates, she presented them a verbal story about an event that they could encounter in their everyday life at any moment, and then she asked them to determine whether there are some mathematical concepts in this event or not. As a result of the research, it is determined that teacher candidates can distinguish about one fourth of the mathematical concepts scattered in real life at a single glance, but some teacher candidates specified words like seat, meal and bus as mathematical concepts. This finding is described by the researcher as misunderstanding of mathematical concepts.

In another study conducted by Lee (2012), real life connections of teacher candidates were examined within the context of story problems. Lee's study also aimed to examine how teacher candidates use their connection skills in their own story problems. One of the study findings indicated that most problems formed by teacher candidates are mainly related to calculations as well as time and money contexts.

On the other hand, it is also possible to see in the literature that there are some studies claiming that teachers and teacher candidates have sufficient competence in this skill compared to other types of connection skills (such as connection between concepts and connection with different disciplines) (Akkuş, 2008; Çoşkun, 2013; Karakoç & Alacalı, 2015).

In the study conducted by Çoşkun (2013), it was aimed to find out in what extent mathematics and classroom teachers use the connection skills in classroom practices and type of connection preferred in general. As a result of the research, it was determined that mathematics and classroom teachers are mostly used real life connections and statements related to connections between different concepts, in their classroom practices. Moreover, it is found out that while statements involving connections between different representations of the concept are less common, statements involving connections between mathematics and different disciplines are rare.

Karakoç and Alacacı (2015) have conducted a study on the real life connections examples of 16 high school mathematics teachers as well as 8 academicians in the field of mathematics teaching and their opinions about the advantages and disadvantages of the usage of these examples in the classroom environment. As a result of the research, it is found out that mathematics teachers and academicians could present logical and meaningful examples of real life connections for almost all high school mathematics subjects. For instance, the use of computer software and algorithms as examples in the teaching of logic within the real-life context has been considered as a practical example. Similarly, in the study which is conducted by Akkuş (2008) with pre-service elementary mathematics teachers, the mathematical concepts and real life connection levels of pre-service teachers were examined. As a result of the research, it was determined that pre-service teachers have sufficient level of connection skills and their skills are increased in accordance with the students' year of education. At the same time, it is found out that there was an association between pre-service teachers' mathematical self-efficacy and their level of connecting mathematics to real life.

1.2 The Statement of the Problem and the Purpose of the Study

Regardless of the fact that they are already emphasized in the curriculum and in many different sources, issues regarding to classroom practices of the student making mathematical connection skills, how students establish these connections and connection skill levels of the students still need to be answered. Looking at the literature on mathematics education, it can be seen that there are few studies for the measurement of students' connection of mathematics to real life. As mentioned in the introduction part, studies conducted in this field are often limited to teachers or teacher candidates. Gainsburg (2008) also states that such studies are limited by emphasizing that studies on the connection skill of mathematics to real life are examined either in a narrow context such as verbal problems, or in terms of teacher candidates. For that reason, the purpose of this research is to examine the 8th grade student's skill of connecting mathematics to real life. This research sought an answer to the following research question:

"What is the 8th grade students' level of connecting mathematics to real life? How these real life connections are established by students in each level?

2. Method

2.1 Research Design

This research is based on the survey design as it aims to determine the current status of the middle grade students' skills of connecting mathematics to real life. In the study, 8th grade students were provided with examples from real life situations, and subsequently they were asked to connect these situations with mathematical concepts and consequently their responses to the scale were examined in detail.

2.2 Study Group

The study group consists of 176 students in total who are attending 8th grade within the second semester of 2016-2017 academic year in a state school affiliated to Etimesgut district of capital Ankara. Aforementioned school is located in the Etimesgut district center, where the children of socio-economically middle class families are attending. Of the students participating in the study; 44% are female and 56% are male students. Since the study aims to deal with all middle grade mathematics subjects as well as to examine the connections levels accordingly, 8th grade students are chosen as the study group.

2.3 Data Collection Tool

Researchers developed the "Connecting Mathematics to Real Life Scale" in order to measure the mathematics of the 8th grade student's skills of associating mathematics to everyday life. For the development of aforementioned scale, researchers reviewed the relevant literature in detail at first. Subsequently, learning fields and outcomes of the middle grade mathematics curriculum (5th, 6th, 7th and 8th grades) were examined and some of the significant mathematical concepts/ideas for each learning fields were determined. These mathematical concepts are reflection, translation, symmetry, rotation, ratio, angles, number and shape patterns, probability, fractions, time, decimal notation, measurements of the length and area, slope, currencies, equilibrium, coordinate system, ordered pairs and geometric shapes. After the determination of these mathematical concepts, appropriate contexts are devised in accordance with the life experiences and age-group level of students. These contexts included the followings; a patterned carpet with geometric shapes on it, a lottery ticket, a tailor who is making dress pattern, a family who are painting their walls, a stallholder who is selling at the bazaar, a children's playground, getting airplane tickets and bus services. Looking at the scales designed for the measurement of connection skills in literatures, we can encounter with measurement tools in which daily life status

(Umay, 2003) and mathematical concepts are directly addressed (Erturan, 2007; Akkuş, 2008; Pirasa, 2016). It has been decided that the measurement tool should be presented to the students as visuals within the framework of the specified context; taking into account that the presence of verbal expressions on such scales and the idea that direct questioning of the connection between given mathematical concepts and everyday life may lead students to give fruitful responses. Instead of asking students how and where they are using mathematics in their daily life, they are provided with photographs that are thought to reflect life situations more realistically. At the introduction of questionnaire, one of these photographs is presented as an example to give students an idea about how to fill the questionnaire (see Figure 1).

Real life situation	Mathematical concepts/terminology	Connection
	Negative and positive numbers	When the ground floor is considered as 0, the floors below the ground floor show negative numbers. For example, “I parked my car at -2nd floor”. The meaning of -2 in the sentence is that we go down 2 levels from the ground level.

Figure 1. Sample item which is presented to the students within the scale

As shown in the Figure 1, real life situations presented to the students in photographic form within the questionnaire at first. Students are asked to find mathematics in this real life situation. Students are not only asked to write about the mathematical concepts presented in the photo but also asked to explain how they connected these mathematical concepts to real life within the scale. For that reason, students are asked to write the mathematical concepts that come to their mind for this photograph and then asked to write how they connect these concepts with real life situations. The scale consists of 8 items and the contexts of each photograph (which indicate each items) as well as their relevant mathematical concepts are presented below in the Table 1.

Table 1. The contexts of each scale items and their relevant mathematical concepts

Item No	Context	Mathematical Concepts
1	Patterned Carpet	Reflection, symmetry, translation, rotation, triangle, rectangle, equality and similarity, shape patterns
2	Lottery Ticket	Probability, fractions, time measurement units, ratio, whole numbers, decimal notation, currencies
3	Tailor	Length measurement, ratio
4	Wall Painting	Area measurement, slope, ratio, angles, Pythagorean theorem, isosceles triangle, right-angled triangle
5	Bazaar	Whole numbers, decimal notation, equality, inequality, ratio, equation, fractions
6	Children’s Playground	Equality, slope, inequality, geometric shapes (circle), right triangle, Pythagorean theorem
7	Airplane seat number	Coordinate system, ordered pairs
8	Bus services	Number patterns, time measurement units

As it can be seen from Table 1, it has been carefully considered that each of the photographs on the scale represents a different context and mathematical concept. Students are given one period (lesson) to fill their scale. The pilot study is conducted with 67 students in total, who are attending 8th grade in a state school affiliated to Altındağ district of capital Ankara. The scale was also examined by two experts who have doctoral degree in mathematic education. Experts were asked whether the photographs used in the scale is understandable, the instructions given in the scale is clear and the photographs represent the mathematical concepts or not, and then relevant changes are made on scale in accordance with opinions of the experts and the results of the pilot study. In order to ensure content validity, it have been carefully considered that the scale properly include all significant learning fields and mathematical concepts in the mathematics curriculum. The reliability of the “Connecting Mathematics to Real Life Scale” is calculated with Cronbach-α coefficient. The Cronbach-α reliability coefficient of the 8-item scale is calculated by using SPSS 20 package software and found as 0.73.

2.4 Data Analysis

The participating students' responses to the items of scale which is developed with the intention of measuring 8th grade students' skills of connecting mathematics to real life are coded on the basis of some studies in the literature (Umay, 2003; Garii and Okumu, 2008) as well as the comments of students. The first two researchers have done the coding together, inconsistent points have been discussed and a common decision has been reached. For coding, each student paper was named S1, S2, ... S176, and each paper was examined separately in terms of items. Some of the codes which are used in order to describe students' skills of connecting mathematics to real life are: "seeing mathematics only in numbers", "seeing mathematics only as geometric shapes" and "limiting mathematics to shopping". At the subsequent stage of data analysis, the codes describing similar connection skills are combined to form general categories (levels) that define the mathematical connection skills of students and in this context it is defined that there are four different connection levels. The most common connection design for each student as well as the general connection level (such as Level 0, Level 1, etc.) of that student is determined. The codes that each level contains as well as students' responses in each level are discussed in detail in the following results section by presenting examples from the scale items.

3. Results

The purpose of this research is to determine the levels of 8th grade students' skill of connecting mathematics to real life and subsequently to discuss the characteristics of each level in detail. For that reason, first of all, student papers are examined in detail and four levels of connection are defined. Table 2 contains brief descriptions of each level as well as the frequency and percentage values of students at each level.

Table 2. The levels of 8th grade students' skill of connecting mathematics to real life, frequency and percentage distributions at each level

Connection Skill Levels	Descriptions	f (%)
Level 0: Non-mathematical connection	Mathematical connections that are irrelevant, empty, or incorrect Connecting the given real life situation with an irrelevant concept or establishing a non-mathematical connection	41 (23.3%)
Level 1: Seeing mathematics only in numbers, geometric shapes and objects	Connecting mathematics in real life with numbers and shapes only	71 (40.3%)
Level 2: Connecting mathematics to calculations	Starting to be aware of mathematical elements in real life situations but think of them only in the context of calculation	25 (14.2%)
Level 3: Mathematical connections	To be able to recognize the mathematical elements in the real life situation and explain it using proper terminology To find more than one connection in real life situations.	39 (22.2%)

As it can be seen from Table 2, the most typical characteristic of Level 0 is that students at this level cannot recognize mathematics in real life or make incorrect mathematical connections. Approximately 23% of the students are at this level. Level 0 students are usually focused on non-mathematical elements in real life. For example, one of the students at this level stated that "*There isn't any connection between mathematics and the carpet. People use carpets only at their homes and workplaces*" (S75) while answering the scale item on 'patterned carpet with geometric shapes on it'. Another example of student response at this level can be given from the item of 'children playground': "*It is very good for young children as they are having fun*." (S108). It can be said that this student at this level did not recognize mathematics in real life focusing on non-mathematical elements in real life. Another example from this level can be provided from the responses of students to scale item on 'lottery ticket'. For instance, one of the students (S52) at this level made an incorrect mathematical connection by associating the lottery ticket numbers (such as 0, 8, 2, 9, 4, 5, 5) to negative numbers and stating that "*There are negative numbers here; 0,8,2,9,4,5,5*". Another example related to incorrect connection can be provided from the scale item of 'bazaar'. For this scale item; it has been observed that, one of the participating students (S157) connected bazaar to probability concept and made a mathematically meaningless explanation as "*the probability of a red apple to a yellow apple*". As it can be seen from the examples, it was determined that the students at this level did not recognize mathematics in real life and made mathematically meaningless connections. Both student responses are presented in Figure 2.

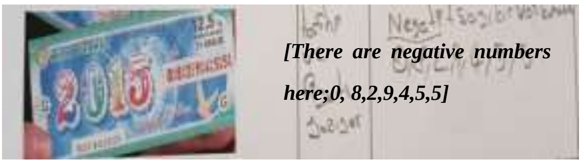
Lottery Ticket Item	Bazaar Item
	

Figure 2. Responses given by students who are defined as Level 0 for the scale items of lottery ticket and bazaar

Unlike Level 0, in Level 1 and Level 2 students have started to recognize mathematics in real life and they were also able to connect real life situations to mathematical concepts. However, students at these levels thought that mathematics is simply about the numbers, four operations, calculations, or geometric shapes. Approximately 40% of the 8th grade students are in Level 1, whereas 14% of them are in Level 2. A student's response (S64) to the scale item of 'patterned carpet with geometric shapes on it' can be illustrated as an example for Level 1. This student made a very general and superficial statement by stating that "*When I look at this fancy carpet, I can see rectangles and other shapes in real life and this proves that mathematics is everywhere*" which suggest that he sees mathematics only in geometric shapes. Similarly, focusing on a child sliding cylinder for the scale item of 'children playground' by one student (S105) suggest that she sees mathematics only in geometric shapes. Another example of student responses at this level can be shown with scale item of 'airplane seat number'. The fact that a student (S13) has made a statement as "*the numbers are used as seat numbers here*" shows again that this student only sees mathematics as the numbers.

The typical characteristic of the Level 2 is that students have started to recognize mathematics presented in real life as in Level 1. Here, unlike Level 1, the student is no longer focusing solely on numbers and shapes, but is starting to calculate and operate by connecting the given situation with meaningful contexts. For example, in 'patterned carpet with geometric shapes on it' scale item; Level 1 student is focused on the geometric shapes of the patterned carpet, whereas Level 2 students made a remarkable statement as "*The short side of the rectangle carpet is 4 meters whereas the long side is 6 meters, therefore the carpet's area is* $6x4=24m^2$ *and perimeter is 20 meters*". This example is an important finding which shows the difference between Level 1 and Level 2. Another Level 2 student's response (S173) to this scale item is "*When we compare carpet area with room area, we can express whether the carpet can fit in the room or not and whether we can put the carpet on ground vertically or horizontally*". For the scale item of 'lottery ticket', one of the students (Ö124) said that "*If I purchase 3 of this ticket, it will be 37,5 Turkish Liras*". For the scale item 'airplane seat numbers' it was determined that Level 2 students (S32) not only focused on the numbers of seats like Level 1 students, but also made calculations which includes "*they will pay money for tickets depending on how many people will go for a trip or they will tell when they are arriving if their families call them*". Another student (S7) from Level 2 stated that "*If I buy 1 kg apple for 3 Turkish liras and 4 kg cherry for 4 Turkish liras in the market, I could find out how much will I pay to cashier*" for the scale item of 'bazaar'. The Level 2 students' responses show that students at this level use mathematics in real life only when calculating or operating.

On the other hand, Level 3 is defined as the highest level and Level 3 students can establish different mathematical connections within the real life situations. Unlike Level 2, these students are not limited to numbers, shapes, or calculations only and they are expected to recognize mathematics hidden in real life. For example, at the scale item of "patterned carpet with geometric shapes on it', Level 3 students are not only focused on the geometric shapes of the carpet, but also realized that the patterns formed by these geometric shapes as well as the mathematical reflections and translations of shapes on the carpet. One of the students (S7) stated that "*Geometric shapes are combined to obtain new geometrical forms and these forms are gathered together to create fancy patterns*" and another student (S27) stated that "*The center of this carpet is the origin and we can get the reflection of 1st region first via x-axis then via y-axis and then again via x-axis*". These student statements are proving that the Level 3 students properly understand the mathematical concepts. These student statements for the item scale of 'patterned carpet with geometric shapes on it' are presented as an example in Figure 3. Another example for Level 3 can be provided from item scale of 'airplane seat number', for this item one of the students (S86) said that "*We can take advantage of ordered pairs when we try to find our seat on the airplane. For example; (3, A) is like A of the 3rd order*", this indicates that the students correctly understood the mathematical concepts. It has been observed from aforementioned examples that students can connect the finding of location via coordinate system with real life situations as stated in 8th grade mathematics curriculum prepared by Ministry of National Education (MEB, 2017).

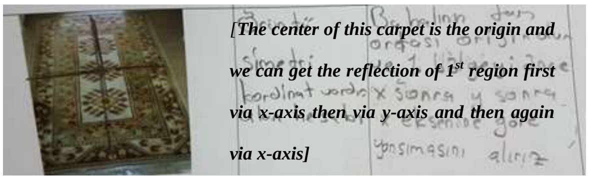
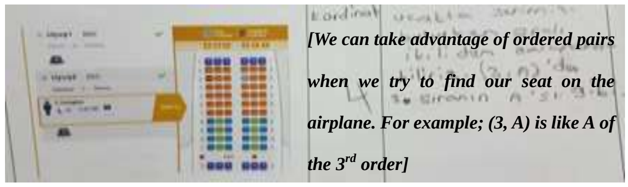
Patterned Carpet Item	Seat Number Item
	

Figure 3. Level 3 students' responses given to the scale item of carpet and seat numbers

It has also observed that Level 3 students made multiple mathematical connections for real life situations. For example, in a children playground item scale, it has seen that a Level 3 student not only associated equality to seesaw but also connected slope to slides by commenting that "*If two people with same weight sit to the left and right sides of the seesaw, there will be balance. Slides are examples for the slope concept in daily life*".

Similarly, for the 'children playground' scale item another student commented that "*When two people are using the seesaw, the heavier person lifts the lighter one. Heavier one remains in the ground but if they have equal weights, they will remain constant*". This comment indicates that this student made a correct connection between the mathematical concepts and the real life. It is noteworthy finding that approximately and only 22% of the students are defined at this level.

4. Discussion and Conclusion

The study findings indicate that participating 8th grade students' skills of connecting mathematics to real life is not at sufficient level. It is found out that, students usually establish superficial connections between mathematics and real life. In other words, it is observed that, most of the students can only connect mathematics in real life with numbers, shapes and calculations. This finding is parallel to the results of other studies with students, teachers and teacher candidates within the literature (Erturan, 2007; Umay, 2003; Garii & Okumu, 2008; Lee, 2012; Özgen, 2013). In her work with pre-school teacher candidates Umay (2003) has determined that most of the teacher candidates do not know much about mathematics and that they do not recognize much about the place of mathematics in real life. In addition, in her research she found that very few teacher candidates distinguish positional expressions, while the majority of teacher candidates can easily distinguish mathematical concepts/elements presented as numbers and quantities. At the same time, despite the fact that the vast majority of teacher candidates are able to provide examples from mathematics in real life, these examples were found to be limited to shopping, time calculations and four operations only.

The fact that the students usually approach the given real life situations within the context of numbers and geometric shapes may be due to the fact that numbers and shapes are the most easily perceived concepts in everyday life. The vast majority of the students are at Level 1 is an indicator that numbers and shapes are coming to people's mind first when we talk about the mathematics. Erturan's thesis study (2007) also shows similar results; it is found out that when the students asked to provide examples for mathematical operations, most of them gave examples from shopping and money calculations. It is also observed that most of the participating students realized that they use mathematics in grocery shopping, but they did not recognize the mathematics in situations like tooth brushing in which the use of mathematics is lesser known. These situations can be interpreted as the fact that students could not transfer classroom mathematics into the real life.

One of the most significant findings of this study is that the highest level observed among the students after Level 1 is Level 0 which indicates that students could not establish mathematical connections correctly. The fact that Level 0 students' connection of mathematical concepts to real life is incorrect shows that they could not comprehend mathematical concepts in a meaningful way. In fact, most of the Level 0 students have established incorrect mathematical connections and presented meaningless examples for connecting skills. This finding is parallel to some of the findings of Akkuş (2008)'s study in which she examined the connection skills of pre-service elementary mathematics teacher. In her study, Akkuş presented daily life situations (contexts) to the pre-service teacher and asked them to connect contexts with concepts. In her study, while the majority of pre-service teacher were able to connect probability concept to real life, they did not make meaningful connections between the mean concept in mathematics and the real life situation presented in the context of blood types. Similarly, in this study, it is also found out that students gave meaningless examples for some mathematical concepts. This demonstrates that some of the students cannot recognize mathematical concepts correctly and therefore they cannot recognize the use of these concepts in real life.

The renewed Ministry of National Education Curriculum of 2017 emphasizes the explanatory explanations on the basis of educational objectives for the connections of mathematics with real life and mathematics with itself. The middle grade mathematics curriculum (5th, 6th, 7th and 8th grades) highlights the importance of connection skills and it also clearly states some of the indicators that should be considered for the development of this skill (MEB, 2013). Although such developments are made, it is thought-provoking that some of the students still have lower connection skills. Küpcü (2010)'s study examined the primary school (6^{th} to 8^{th} grade) mathematics curriculum within the framework of connection skills, and it is emphasized that although primary school mathematics lesson curriculum revealed important objectives for the development of the students' connection skills, it is necessary to organize different activities in order to carry out this development process more effectively. However, the conducted researches argue that even though there are curriculum and textbooks for the development of connection skills, they do not guarantee students to improve their connection skills (Mosvold, 2008; Lee, 2012). The amount of real life connections in the curriculum does not show the quality of the real life connection in the actual classroom practice (Lee, 2012). For instance, in his study, Mosvold (2008) analyzed TIMMS 1999 videos in order to monitor how teachers in the Netherlands and Japan did mathematical connections in their classes. Mosvold (2008) found out that Dutch textbooks used in the class mainly contain real life situations. He stated that, although Dutch classes used more connection examples than Japanese classes, these examples presented to the students in traditional teaching methods in which students are less active. This result supports the Lee (2012)'s conclusion that the amount of real life connections will not show the quality of the real life relation in classroom practices. For that reason, we can say that the reason of the low connection skills of students might be partly due to the fact that teachers do not pay much attention to the connection of mathematics to real life in the classroom environment.

In conclusion, findings reveal the importance of restructuring of middle grade mathematics classes to support the development of connection skills. Mathematics is not just a set of rules to be applied in life. For that reason, the meanings of mathematical concepts and their use in the real life should be emphasized and discussed apart from the solely teaching of these rules. In this research, very few students were able to think of mathematical concepts in real life and most of them only focused on calculations, shapes and numbers. It is also noteworthy to state that when we look at the connections established by the students, we can see that students at the highest level (Level 3) have established multiple (more than one) connections. Students' ability to establish different connections and to eliminate the gap between school mathematics and real life is depending on how much they could transfer their classroom mathematical knowledge to the real life. For that reason, teachers have great responsibility.

This research contributed to the literature with the definition of four different connection levels. Although the definition of these levels is open to debate, they may be considered as a starting point for the researchers seeking to conduct a study in this area. Although this scale is developed for measurement of students' connection skills, it can also give some clues for teachers and textbook writers to prepare examples for classroom practices in order to support the development of this skill and to enhance the quality of real life connected problems in textbooks.

One of the limitations of this research is that the connection skills of middle grade students are examined only in the context of real life. In the future studies, the examination of connection skills between different disciplines and concepts will provide more detailed and comprehensive information about the connection skills of the students. This scale developed at the same time is limited in some contexts (such as children's playground, bazaar) in accordance with the experiences of the middle grade students. The presentation of different contexts through measurement can make a difference in the connection skills of students. In this sense, there is a need for studies on how middle grade students can differentiate in different contexts of real life in order to be able to examine the skills of connection.

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